Self-rated walking pace and all-cause, cardiovascular disease and cancer mortality: individual participant pooled analysis of 50 225 walkers from 11 population British cohorts

TITLE

Self-rated walking pace and all-cause, cardiovascular disease, and cancer mortality: individual participant pooled analysis of 50,022 walkers from 11 population British cohorts

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ABSTRACT

Background/Objectives: Walking pace is thought to be associated with risk of premature mortality. However, the independence of this relationship from total volume of physical activity, ~~non-occupational~~leisure time physical activity and highest physical activity intensity reached remain unclear. We examined the associations between walking pace and cause-specific mortality, investigating the potential modifying effect of these factors, as well as age, sex and BMI.

Methods: Prospective pooled analysis of 11 population-based baseline surveys in England and Scotland between 1994-2008 that were linked with mortality records. Multivariate-adjusted Cox proportional hazards models examined associations between walking pace (slow, average, brisk/fast) and all-cause, cancer, and CVD mortality.

Results: 50,022 walkers were entered in the analyses. Compared to self-reported walking at a slow pace, walking at average or brisk/fast pace was associated with a reduced risk of all-cause mortality (20% (95%CI=11-27%) and 23% (95%CI=12-32% respectively), and CVD mortality (23% (95%CI=8-35%) and 19% (95%CI=-2-36% respectively). In stratified analyses, such associations were evident amongst those over 50 years, those not meeting the physical activity recommendations, and those who did not undertake vigorous intensity activity. There was no interaction effect of sex or BMI. No association was seen between pace and cancer mortality.

Conclusion: Walking is known to benefit health. Assuming causality, these analyses suggest that increasing walking pace could reduce risk for all-cause and CVD mortality. Walking pace could be emphasised in public health messages, especially in situations when increase in walking volume or frequency is less feasible.

Keywords

Walking, physical activity, mortality, walking pace, epidemiology, public health, cardiometabolic, cohort studies

INTRODUCTION

Increasing population level walking remains a key focus of physical activity (PA) promotion. Regular walking is known to confer many physical, mental and social health benefits.[1] Meta-analyses of cohort studies have sought to quantify the association between regular walking and reduction in risk for all-cause mortality (ACM).[2-4] Kelly et al., (2014) estimated that after adjustment for other PA, walking at a volume equivalent to PA guidelines was associated with an 11% reduction in risk for ACM compared to no walking.[5]

Considering other health endpoints, cardiovascular disease (CVD) and cancer are the two most common avoidable causes of mortality in the UK.[6] ~~Considering other health endpoints,~~ Hamer and Chida (2008) conducted a meta-analysis of 13 cohort studies and found a 31% reduction in risk of CVD ~~cardiovascular disease (CVD)~~ mortality in the highest walking categories compared with the lowest walking volume/intensity category.[2] A recent, large analysis of over 250,000 adults in the UK found walking commuting was associated with a 36% reduction in risk of CVD mortality compared to non-active commuting.[7] The results for cancer mortality are less clear, with, for example, Matthews et al., (2007) and Celis-Morales (2017) finding no significant associations between walking volume and cancer mortality in large cohort studies.[7 8]

According to principles of overload a higher relative activity intensity achieved by a faster pace of walking would provide the stimulus to produce a greater physiological response, and more substantial or even additional health benefits. Acute studies have shown that walking at a faster pace results in greater physiological responses[1]. However, while total volume of walking e.g. by distance or time has been frequently studied[2-5], less is known about the long-term health effects of habitual walking pace.

A Copenhagen City Heart Study analysis[9] reported reduced risk of heart failure for moderate and high walking speed compared to slow speed. The authors also suggested that walking pace may have a stronger association with heart failure than total duration of walking. Manson et al.,[10] found that among 73,743 postmenopausal women aged 50-79 years walking pace was associated with reduced incidence of cardiovascular disease (CVD) in a dose-response fashion. In a 40-year follow up of the Whitehall study of 6,981 British civil servants, Batty et al.,[11] compared slow walking pace to high walking pace and found a reduced risk of all-cause, coronary heart disease (CHD), and total cancer mortality. None of these studies adjusted for total volume of PA and it is therefore unclear if the reported effects were partly attributable to the higher overall activity levels of brisk/fast walkers.
A recent analysis of 420,000 UK Biobank Participants found significant associations between higher walking pace and reduced risk of all-cause and cardiovascular mortality, but inconsistent findings for cancer mortality[12]. However, the UK Biobank had a response rate of 5.5% and concerns have been raised about the generalisability of non-genetic associations from very unrepresentative cohorts[13].

In summary, walking pace has been found to be associated with reduced risk of all-cause and cause-specific mortality in a number of cohort studies but the literature on the whole has not addressed independence from total and ~~non-occupational~~leisure time PA robustly. There remains a knowledge gap about the independence of the relationships between walking pace and mortality outcomes in large population cohorts.

Our aim was to examine the associations between self-reported walking pace with all-cause, CVD and cancer mortality in a population representative sample of 11 pooled population

British cohorts. A secondary aim was to better understand the role of total and total ~~non-occupational~~ leisure-time~~and~~ PA, sex, age, and BMI as potential moderators of these associations.

METHODS

Sample

The Health Survey for England (HSE)[14] and the Scottish Health Survey (SHeS) [15] are established household-based population surveillance studies running since 1991 and 1995, respectively. Each year samples are selected using a multistage, stratified probability design aimed at recruiting a nationally representative sample of adults living in private households. Trained interviewers visited the selected households, and the recruited participants were administered the study questionnaires. 91.6% of survey participants gave written consent to have their death flagged on the NHS Central Mortality Register. For this analysis we used data from HSE 1994, 1997, 1998, 1999, 2003, 2004, 2006 and 2008 and SHeS 1995, 1998 and 2003. As population mortality rates increase evidently from the 4th decade of life, ~~W~~we included individuals aged ≥30 years old who reported at least one occasion of walking in the last four weeks, had no doctor-diagnosed or self-reported (long standing illness module) ischemic heart disease, angina, or stroke, and no prevalent cancer through cancer registration records or self-reported (long standing illness module). We chose 30 years as the lowest age for inclusion in the study because mortality events An occasion of walking was variously defined as at least 10 minutes or at least 15 minutes or at least 30 minutes in the different baseline surveys[16]. Each baseline survey was approved by the relevant Research Ethics Committees in England and Scotland.

Mortality outcomes

Participants were followed up for mortality until 31/12/2009 (SHeS) or 31/03/2011 (HSE). Diagnoses for primary causes of death were recorded according to the International Classification of Diseases, Ninth Revision (ICD9) and Tenth Revision (ICD10). Cancer deaths were identified using ICD9 140.0-239.9 and ICD10 C00.0-D48.9 codes; CVD deaths were identified using ICD9 390.0-459.9 and ICD10 I01.0-I99 codes.

Assessment of walking and other physical activity

PA was assessed using a ~~researcher~~interviewer-~~led~~ administered questionnaire that inquired about walking, domestic PA, and participation in sports and exercises in the four weeks prior to the interview[16]. Walking was assessed using a question on number of days walked in the last 4 weeks, the average amount of time spent walking on each day, and the usual walking pace ("which of the following describes your usual walking pace: slow pace, average pace, fairly brisk pace, fast pace-at least 4mph"). Because some baseline surveys (HSE 1994/1999/2003/2004; SHeS 1995) did not enquire about walking duration per reported occasion we imputed this information based on the age and sex-specific averages of HSE 1997/1998 and using methods described elsewhere[17]. All PA variables were summarized to reflect weekly averages for easier comparison with currently recommended amounts. The criterion validity of the walking-related questions is unknown. In a convergent validity study of over 2000 adults, the Spearman correlation coefficients between accelerometry counts and walking of brisk/fast pace were 0.35 (95% confidence interval (CI): 0.31, 0.40) for women and 0.28 (CI: 0.23, 0.34) for men[18]. The equivalent coefficients for total weekly questionnaire derived MET-minutes were 0.41 (CI: 0.36, 0.46) for women and 0.32 (CI: 0.26, 0.38) for men[18].

The PA compendium[19] was used to assign the Metabolic Equivalents (MET) for all PAs to calculate total MET-hours/week. We estimated adherence to the general guideline[20] as accumulating weekly at least 150 minutes of moderate intensity or 75 minutes of vigorous intensity or equivalent combinations of moderate and vigorous (~~non-occupational~~leisure time) PA[20]. We also calculated highest physical activty intensity reached on at least one occasion over the ~~in the~~ last four weeks that the PA questionaire time frame covered (light/moderate/vigorous).

Covariates

Height and weight were measured by the interviewers using standard protocols[14 15]; body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared. Additional questions assessed age, educational attainment (age completed full time education), presence of longstanding illness, weekly frequency of alcohol consumption, smoking habits (never smoker, ex-smoker, currently smoking 1-9 cigarettes/day, currently smoking 10-19/day, currently smoking ≥20/day), psychological distress/depression (12-point General Health Questionnaire score), total leisure time PA volume (MET-hours/week) and total walking volume (MET-hours/week).

Statistical analysis

Analyses were conducted using SPSS version 22 (SPSS, Inc). Cox proportional-hazard models with time in study as the time-scale were used to examine the associations between walking pace and all-cause, CVD, and cancer mortality with “slow pace” as the reference category. Walking pace was originally entered in its original 4 categories format but the low number of events in the “fast pace” category resulted in unstable estimates and broad 95%

CIs; for this reason, all main analyses were carried out with "fairly brisk" and "fast" pace categories collapsed into one group. In a supplemental analysis we entered walking pace in its original format.

Kaplan Meier log-minus-log plots were used to examine the proportional-hazards assumption and no violations were observed. Analyses were adjusted for age, sex, all covariates listed above, total volume of ~~non-occupational~~ leisure time PA (weekly MET-hours), and highest PA intensity reached. Occupational PA could not be used in the calculation of PA volume because of its non-quantitative nature (it ~~is~~ was reported as very/fairly/not very/not at all physically active). We chose not to adjust for occupational PA level in the main Cox models because of the large number of missing values (n≈27,000) due to the corresponding question missing from SHeS 1995 and for responses being dependant on employment status. ~~For these reasons we conducted a sensitivity analysis in the sub-sample who had valid occupational activity information (n=30,089).~~

We examined effect modification by ~~gender~~sex, age, and total ~~non-occupational~~ leisure time PA level using Type 3 Wald chi-square statistics for the interaction term in the partially adjusted (for age, sex, and cohort/year) model. For interactions with $p<0.010$ we performed stratified analyses[20]. To minimize the possibility of spurious associations due to occult disease we ran a sensitivity analysis where we both included and excluded participants who died in the first 24 months of follow-up.

RESULTS

In total, 65,381 participants were initially considered; 4,811 participants (8.4% of total eligible) did not consent to follow up and were excluded. The variables with the highest number of missing data were BMI (n=6,346), GHQ score (n=2,444) and smoking (n=151). In total, there were 3617 deaths from any cause including 1014 from CVD and 1276 from cancer causes. The mean follow up was 9.2 (SD=4.6) years, corresponding to 469,235 person years. **Table 1** presents the sample characteristics for the 50,225 individuals in the analytical sample. Slower walking pace was associated with older age, female sex, higher BMI scores, reporting a long-standing illness at baseline, and indications of psychological distress. Faster walking pace was associated with being a smoker, high frequency of alcohol consumption, finishing education after age 19 years, meeting the PA recommendations, participating in higher intensity PA, high volumes of total ~~non-occupational~~ leisure time PA, and higher frequency and total duration of walking. Walking pace (in its original 4-group format) showed low magnitude correlations with total leisure time PA volume (Spearman rho=0.25) and walking volume (rho=0.20).

Table 2 presents the associations between walking pace and the three mortality outcomes with all participants who had an event in the first 24 months of the follow-up excluded (n=49,731). In the fully adjusted models, walking at an average pace was associated with a risk reduction for ACM of 20% (95%CI:~~11~~12-~~27~~28%) compared with those walking at a slow pace. The respective risk reduction for those walking at brisk/fast pace was ~~23~~24% (~~12~~13-~~32~~33%). For CVD mortality, walking at an average pace was associated with a ~~23~~24% (~~8~~9-~~35~~36%) risk reduction and walking at a brisk/fast pace was associated with ~~19~~21% (~~2~~1-~~36~~38%) risk reduction compared with those walking at a slow pace. There was no evidence to suggest walking at an average or brisk/fast pace was associated with a significant risk reduction in cancer mortality (hazard ratio (HR)=1.08 (0.~~90~~89-1.31) and HR=1.~~03~~ 02 (0.~~82~~81-1.29) respectively). The results were similar in direction and magnitude when those who had an event in the first 24 months were included (**Supplemental Table 1**). When the walking pace variable was entered in its original 4-group format (**Supplemental Table 2**) associations were similar in magnitude and direction but likely due to lower number of events, the 95% CI of the fast pace group were very wide and included 1 for all three outcomes. Repeating all above analyses with the models adjusted for total duration of MVPA and light intensity activity (instead of average MET-hours per week) produced almost identical results, for example the HR(95%CI) for all-cause mortality in the average pace group changed from 0.80 (0.72 to 0.88) to 0.80 (0.73 to 0.88); in the brisk/fast group it changed from 0.76 (0.67, 0.87) to 0.77 (0.68, 0.88) (data available on request).

There were statistically significant interaction effects of walking pace and total ~~non-occupational~~ leisure time PA volume (e.g. p=0.038 for ACM) and highest intensity reached (e.g. p=0.004 for ACM). Significant interaction effects were also found for walking pace and age (e.g. p=0.005 for ACM) but not for sex or BMI.

Stratified analyses by age in two and three groups are presented in **Figure 1** and **Supplemental Figure 1** respectively, and by compliance with the PA recommendations in **Figure 2. Figure 1** shows clearer evidence of a relationship between walking pace and all-cause and CVD mortality, but not cancer mortality, in the over 50s compared to the results for the whole sample. There was little evidence of association in the under 50s. **Supplemental Figure** 1 showed clearer evidence for a relationship of walking pace with all-cause mortality in those aged 45-59 and ≥60 years and with CVD mortality in those aged ≥60 years.

Figure 2 shows clearer evidence of a relationship between walking pace and all-cause and CVD mortality, but not cancer mortality, amongst those that did not meet the PA guidelines compared to the results of the whole sample. For those meeting the guidelines, the direction of effect for all cause and CVD mortality was protective for increasing pace, but very low number of events caused low power and wide confidence intervals.

Figure 3 shows the stratified analyses of walking pace and all-cause and CVD mortality by highest intensity reached; analyses were not performed for cancer mortality due to the low number of events in some cells and the apparent violation of the proportional hazards assumption. There was evidence of a relationship between walking pace and ACM in both the light and moderate intensity groups. There was some evidence for a relationship with CVD mortality in these groups although confidence intervals were wider and there was no dose-response. There was no evidence of a relationship between walking pace and all-cause or CVD mortality amongst the group that reported reaching vigorous intensity.

DISCUSSION

In adults in Scotland and England, walking at average or brisk/fast pace was associated with a reduced risk of all-cause and CVD mortality compared with walking at slow pace. However, there was no evidence of a similar relationship with cancer mortality. Our findings are in agreement with previous studies which have reported that a higher pace of walking was associated with a risk reduction for ACM of between 19%[21] and 42%[11]. Our estimates are within this range, and adjusted for total PA volume (MET-hrs/week), considered occupational PA, and highest PA intensity reached. We found that the associations between pace and all-cause mortality persisted after controlling for total non-occupation PA which is consistent with studies that controlled for total walking energy expenditure[22] and moderate and vigorous PA[12]. Batty et al., reported a 20% reduction in cancer mortality for walking fast.[11] Similar to Yates et al., (2017)[12] we did not find any evidence of this effect.

Possible explanations

The association between pace on all-cause and CVD mortality may be explained by the increased relative exercise intensity elicited by a faster pace providing a greater stimulus for physiologic adaptations[23] in functions known to influence CVD mortality. This may be further confirmed by the observation that the associations of walking pace with ACM and CVD mortality were considerably weakened for the subsample of participants that have achieved vigorous intensity in non-walking physical activity.

We did not find an effect of pace on cancer mortality. Volume may be more important than pace for cancer mortality. Alternatively we know that different cancers have different relationships with PA, and that if we had examined mortality from specific malignancies e.g., breast and colon cancer a relationship may have been observed[24].

We did not find evidence for associations for the younger participants, the physically active, or for those reaching vigorous intensity, but recommend caution when interpreting these findings. Low number of events in strata increased uncertainty. It is possible that older age and lower PA status (total or intensity) predict lower aerobic fitness (maximal oxygen consumption). As such, that the relative intensity of walking at faster pace may be equivalent to the upper end of moderate intensity or even vigorous intensity, and therefore provides a greater physiological stimulus for maintaining cardiovascular function and promoting health.

Separating the effect of one specific aspect of physical activity and understanding, its potentially causal association with mortality is complex. Our data suggest that participants who usually walk at a brisk/fast pace are overall the most active and probably the healthiest. ~~Finally~~, Although it is biologically plausible that walking at a higher pace leads to better health overall and cardiovascular health specifically, it is also likely that walking at a faster pace is a marker for better health ~~and~~, fitness, and physical function, which predicts the risk for mortality in the following years. In other words, walking pace may be a predictor and not a causal factor of lower mortality risk.

Strengths and limitations

The strengths of the present study include the large sample comprising a series of baseline surveys that were roughly representative of the population in England and Scotland, the very high response rates, and the relatively long follow up. The results can be generalised to the UK population with more confidence than previous estimates. To our knowledge this is the first such study to report associations between walking pace and all-cause, CVD, and cancer mortality and adjust for total PA volume and highest intensity reached. We also present novel analysis of associations stratified by age, total ~~non-occupational~~ leisure time PA and highest intensity reached to investigate important potential effect modifiers.

Limitations include: the exposure “walking pace” and other variables such as “total PA” were self-reported and therefore subject to misclassification and other biases. Further misclassification may have been introduced by the imputation of walking duration for a number of baseline surveys[17], and this may be partly the reason why adjustments for total walking volume had negligible impact on the estimates. The repeated~~-~~ cross-sectional nature of HSE and SHeS ~~the survey data~~ meant we could not assess or account for temporal changes in walking behavior within individuals. The analyses controlled for a comprehensive set of covariates in addition to PA, although we cannot discount the possibility of residual confounding. Some stratified analyses had too few events and therefore may not have been powerful enough to detect associations or lack of association with confidence.

Implications and future research

The additional protective effect demonstrated from higher walking pace may have implications for public health messaging. Walking is a cornerstone of PA promotion for public health, but volume of walking (steps per day) has often been emphasised. Given the perceived time barrier cited by those who fail to meet current PA guidelines[25], a pace change could be more feasible (for those with adequate physical capacity) than increased volume or duration. We encourage the Chief Medical Officers' Physical Activity Guidelines Committee to consider this in their upcoming revision of the PA Guidelines. Further experimental research is warranted to establish if a randomised intervention based on pace elicits important physiological change[26].

Conclusions

Walking is known to benefit health. Assuming causal relationships, these analyses suggest that increasing walking pace could be linked with lower risk for all-cause and CVD mortality. Walking pace should be emphasised in public health messages, especially in circumstances when increase in walking volume or frequency is less feasible.

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FIGURE LEGENDS

Figure 1: Associations between walking pace (3 groups) and all-cause, cardiovascular disease, and cancer mortality by age group (<50 vs. ≥50 years)[a]. Walkers aged 30 years and over with no diagnosed cardiovascular disease or cancer at baseline[b]. The Health Survey for England and Scottish Health Survey (n=50,225).

50 years of age was selected as a cutoff point due to its proximity to median age for this sample (48 years) [b] Prevalent cardiovascular disease was defined as doctor-diagnosed or self-reported (long standing illness module) ischemic heart disease, angina, or stroke; prevalent cancer was determined through cancer registration records or self-reported (long standing illness module) [c]Model adjusted for sex, cohort, long-standing illness, alcohol drinking frequency, psychological distress, body mass index, smoking status, education level, total physical activity volume (MET-hrs/week), walking volume (MET-hrs/week), and highest physical activity intensity reached.

Figure 2: Associations between walking pace (3 groups) and all-cause, cardiovascular disease, and cancer mortality, by physical activity level (meeting vs. not meeting the physical activity recommendations).[a] Walkers aged 30 years and over with no diagnosed cardiovascular disease or cancer at baseline[b]. The Health Survey for England and Scottish Health Survey (n=50,225).

[a] Adherence to the physical activity recommendations was defined as at least 150 minutes of moderate-intensity activity or 75 minutes per week of vigorous intensity activity or equivalent combinatins of moderate and vigorous activity [b] Prevalent cardiovascular disease was defined as doctor-diagnosed or self-reported (long standing illness module) ischemic heart disease, angina, or stroke; prevalent cancer was determined through cancer registration records or self-reported (long standing illness module) [c]Model adjusted for sex, cohort, long-standing illness, alcohol drinking frequency, psychological distress, body mass index, smoking status, education level, walking volume (MET-hrs/week), highest physical activity intensity reached.

Figure 3: Associations between walking pace (3 groups) and all-cause, and cardiovascular disease mortality, by highest physical activity intensity reached (light/moderate/vigorous). Walkers aged 30 years and over with no diagnosed cardiovascular disease or cancer at baseline[a]. The Health Survey for England and Scottish Health Survey (n=50,225).

[a] Prevalent cardiovascular disease was defined as doctor-diagnosed or self-reported (long standing illness module) ischemic heart disease, angina, or stroke; prevalent cancer was determined through cancer registration records or self-reported (long standing illness module) [b]Model adjusted for sex, cohort, long-standing illness, alcohol drinking frequency, psychological distress, body mass index, smoking status, education level, walking volume (MET-hrs/week), and total physical activity volume (MET-hrs/week).

Table 1. Baseline characteristics of the sample by walking pace. Walkers aged 30 years and over with no diagnosed cardiovascular disease or cancer at baseline. The Health Survey for England and Scottish Health Survey (n=50,225).

	Walking Pace				
	Slow Pace	Average Pace	Fairly Brisk Pace	Fast Pace	
					P[e]
Age, mean (SD) (years)	57.8	51.1	47.7	44.6	<0.001
Sex (% female)	61.0	58.5	52.2	40.5	<0.001
Body mass index, mean (SD) (kg/m^2)	28.6 (5.7)	27.3 (4.7)	26.1 (4.1)	25.5 (3.9)	<0.001
Long standing illness [a] (%)	64.6	41.9	35.4	33.0	<0.001
Smoking (% current)	23.9	24.0	21.5	27.5	<0.001
Alcohol frequency (% ≥5 times/week)[b]	18.7	18.7	22.4	24.5	<0.001
Psychological distress (% with GHQ score ≥4)[c]	20.1	11.9	11.6	12.2	<0.001
Age finished education (% finished age 19+)	12.9	18.1	26.3	29.0	<0.001
Meeting the physical activity recommen-dations [d]	8.9	17.2	47.5	52.4	<0.001
Highest PA intensity reached (%)					
No physical activity	11.7	7.9	4.9	4.9	<0.001
Light intensity only	63.4	52.5	14.4	14.8	
Reached moderate inensity	11.8	15.3	42.9	37.2	
Reached vigorous intensity	13.1	24.3	37.7	43.0	
MET-hours of physical activity per week, median (SE)	8.0 (0.38)	17.0 (0.20)	23.1 (0.31)	32.0 (0.80)	<0.001
Number of days walked per week, median (SE)	2.0 (0.04)	2.5 (0.02)	2.5 (0.02)	3.0 (0.05)	<0.001
Time (minutes) walked per week (any pace), median (SE)	67.5 (5.24)	112.5 (2.44)	110.0 (3.10)	130.0 (8.67)	<0.001

[a]Dichotomous variable derived from responses to a series of questions (yes/no) on illness within 8 listed body systems (eg. nervous system, digestive system, heart and circulatory system etc.). At least one illness required to have longstanding illness;[b] derived from the question "on how many days in the last 7 days did you have an alcoholic drink; [c] General Health Questionnaire comprises 12 questions related to psychological health (eg. concentration, feeling depressed etc) the categories were 0, 1-3 and ≥4; [d] at least 150 minutes of moderate-intensity activity or 75 minutes per week of vigorous intensity activity or equivalent combinatins of moderate and vigorous activity;); [e] P-value calculated using Kruskal-Wallis test for continuous variables and likelihood ratio chi-square test for categorical variables.

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	Deaths/n	Model 1[b]		Model 2[c]		Model 3[d]	
		HR	**95% CIs**	**HR**	**95% CIs**	**HR**	**95% CIs**
All-cause Mortality							
Walking Pace							
Slow	576/4101	1		1		1	
Average	1957/25857	0.73	0.67,0.81	0.78	0.71,0.87	0.80	0.~~73~~72,0.~~89~~88
Brisk/Fast	730/19773	0.61	0.55,0.69	0.68	0.61,0.77	0.~~77~~76	0.~~68~~67,0.~~88~~87
P trend linear		*<0.001*		*<0.001*		*<0.001*	
P trend nonlinear		*<0.001*		*0.003*		*0.001*	
Cardiovascular Mortality							
Walking Pace							
Slow	192/4101	1		1		1	
Average	552/25857	0.68	0.57,0.81	0.75	0.63,0.90	0.~~77~~76	0.~~65~~64,0.~~92~~91
Brisk/Fast	193/19773	0.55	0.45,0.68	0.67	0.54,0.83	0.~~81~~79	0.~~64~~62,~~1~~ 0.~~02~~99
P trend linear		*<0.001*		*0.001*		*0.~~143~~089*	
P trend nonlinear		*0.007*		*0.032*		*0.~~008~~007*	
Cancer Mortality							
Walking Pace							
Slow	137/4101	1		1		1	
Average	717/25857	1.03	0.85,1.24	1.06	0.88,1.29	1.08	0.~~90~~89,1.31
Brisk/Fast	297/19773	0.88	0.71,1.08	0.95	~~1.95,~~0.76, 1.17	1.~~03~~02	0.~~82~~81,1.29
P trend linear		*0.152*		*0.478*		*0.~~930~~945*	
P trend nonlinear		*0.338*		*0.269*		*0.~~327~~339*	

[a] Prevalent cardiovascular disease was defined as doctor-diagnosed or self-reported (long standing illness module) ischemic heart disease, angina, or stroke; prevalent cancer was determined through cancer registration records or self-reported (long standing illness module) [b]Model adjusted for age, sex, and cohort; [c]Model also adjusted for long-standing illness, alcohol drinking frequency, psychological distress, body mass index, smoking status, education

level; [d]Model also adjusted for total physical activity volume (MET-hrs/week), walking volume (MET-hrs/week), -and highest physical activity intensity reached.

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